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Application of Problem Based Learning Models to Improve Critical Thingking Skills Mathematically in science two tenth grade class students of Senior High School 1 Salo

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Abstract. This study aims to improve the learning process and improve mathematical critical thinking skills of students of class X IPA-2 SMA Negeri 1 Salo on trigonometric material through the application of Problem Based Learning (PBL) models. This research is a Class Action Research (CAR) which consists of two cycles. The subjects of this study were students of class X IPA-2 SMA Negeri 1 Salo in the academic year 2017/2018 as many as 32 students consisting of 21 female students and 11 male students. Data collection instruments in this study were observation sheets, guidelines for scoring mathematical critical thinking skills, tests and documentation. Data collection techniques in this study are observation techniques and test techniques. The data analysis technique in this study is the analysis of data from the observation and analysis of test results data. The results of this study indicate that there is an improvement in the learning process and an increase in mathematical critical thinking skills of students of class X IPA-2 SMA Negeri 1 Salo. This can be seen from the percentage of students' critical thinking skills before the action and after the action, namely cycle I and cycle II. Before the action, the average percentage of students' critical thinking skills at 60.93% is on the less critical criteria. After being given an action, it increased to 73.82% with a critically sufficient criterion at the end of cycle I and increased to 85.35% at the end of cycle II which reached critical criteria. So it can be concluded that the application of the Problem Based Learning (PBL) model can improve the learning process and improve the ability to think critically mathematically in the tenth grade students of SMA Negeri 1 Salo in the academic year 2017/2018.

Keywords:Problem Based Learning, Mathematical Critical Thinking

1. INTRODUCTION

Learning is a process that can help students to obtain information, ideas, skills, values, ways of thinking, and how to learn. The learning process must really pay attention to the involvement of students in each stage of the activity. "Learning activities emphasize the process and implementation of specific models or methods so that students will learn. Do not accept continuously from educators, but want to find, find and take understanding and experience with educators"[1].

During this time, learning activities in high schools still emphasize changes in thinking skills at the primary level. In mathematics subjects students tend to memorize formulas, but cannot use formulas to the full. Thus, the ability of students is only limited to memorization and has not maximized the ability to think high-level students. Though high-level thinking ability is very important for students to solve problems in real life and are able to develop students' mindset so that the learning process is expected to succeed.

Based on the results of interviews of researchers with mathematics teachers in class X IPA-2 of SMA Negeri 1 Salo conducted on October 16, 2017, information was found that students' critical thinking skills were still low. This is evidenced by the fact that there are still many students who have not been able to solve the critical thinking questions given by the teacher in one of the second daily test questions on SPLTV material.

Based on the observations of researchers in class X IPA-2 SMA Negeri 1 Salo, in the initial activities the teacher had not conveyed the learning objectives and had not motivated students by linking learning material in real life. The teacher presents the material to be studied and apperception to remind students of the previous material. At the core activity, the teacher explains the learning material to students. The teacher gives examples of problems and explains the solutions to students. After that the teacher gives students the opportunity to ask questions, but at this meeting there were no students who wanted to ask questions. The teacher provides training so that students better understand the material presented. Only a few students can solve the problems given by the teacher. The teacher appoints one student to complete it on the board. However, students do not want to, shy, do not dare if not appointed. Students also have not been maximal in analyzing the questions given. In the final activity, the teacher has not directed students to determine the conclusions of the learning material. The teacher forgets to deliver the material to be discussed at the next meeting. From the explanation above, it can be seen that students do not show indicators of mathematical critical thinking skills.

From the results of interviews and observations, researchers conducted tests before action to determine the initial ability of mathematical critical thinking in class X IPA-2 students. Based on the results of the initial mathematical critical thinking test before the action carried out on February 22, 2018, it was found that the students' critical thinking skills in class X IPA-2 at SMA Negeri 1 Salo in the Function material were still low. This can be seen in Table 1. below:

Table 1. Mathematical Critical Thinking Ability of Each Prior Action Indicator

No	Indicator	Percentage (%)	Criteria
1	Analyzing Questions	60,93%	Less Critical
2	Identifying Assumptions	58,59%	Less Critical
3	Determining Solution	67,18%	Quite Critical
4	Determining Conclusions	57,03%	Less Critical

The number of students for each KBKM criterion before the action can be seen in Table 2. Based on the problems that have been described, the authors want to apply the Problem Based Learning (PBL) model which is expected to improve the learning process of mathematics and improve the ability to think critically mathematically in the tenth grade students of SMA Negeri 1 Salo.

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Table 2. Number of Students for Each KBKM Criteria Before Action

Percentage (%)	Criteria	Number of Students	Percentage	Average KBKM
90% ≤ NP ≤ 100%	Very Critical	0	0%	60,93% Less Critical
80% ≤ NP ≤ 89%	Critical	2	6,25%	
65% ≤ NP ≤ 79%	Quite Critical	10	31,25%	
55% ≤ NP ≤ 64%	Less Critical	15	46,87%	
NP < 55%	Not Critical	5	15,62%	
Total		32	100%	

"Problem Based Learning (PBL) is a learning model that requires students to think critically, solve problems, learn independently, and demand the skills to participate in teams"[2]. Problem-Based Learning Steps according Rusman [3] as in Table 3. below:

Table 3. Steps for Problem Based Learning

Fase	Indicator	Phase of Teacher's Behavior
1	Student orientation on the problem	Describes learning objectives, explains logistics needed, and motivates students to engage in problem solving activities
2	Organize students to learn	Helping students define and organize learning tasks related to the problem
3	Guiding individual / group experience	Encourages students to gather appropriate information, conducts experiments to get explanation and problem solving
4	Develop and present the work	Assisting students in planning and preparing appropriate works such as reports, and helping them with various tasks with their friends
5	Analyzing and evaluating the problem solving process	Helping students to reflect or evaluate their investigations and the processes they use.

2. RESEARCH METHOD

The form of this research is Classroom Action Research (CAR). This research was carried out collaboratively, meaning that this research was not carried out alone but in collaboration with mathematics teachers in class X IPA-2 SMA Negeri 1 Salo and colleagues. Researchers are involved in collaboration with teachers in planning, implementing, observing and reflecting. Researchers are observers of teacher and peer activities as observers of student activities. This research was conducted at SMA Negeri 1 Salo in the even semester of 2017/2018 school year starting from March 05 2018 until April 16 2018. The subjects of this study were students of class X IPA-2 SMA 1 Salo. The number of students was 32 students, consisting of 21 female students and 11 male students divided into 6 groups. Each group has 5 students and there are two groups that have 6 students.

In this study, researchers used the Classroom Action Research (CAR) steps according by Arikunto [4]. There are several stages in implementing CAR in this study, namely:

The first stage is planning. At this stage, the researcher prepares an action plan that will be carried out based on the problem and sets the problem solving by applying the

Problem Based Learning (PBL) model to improve the learning process and improve the mathematical critical thinking skills of the tenth grade students of SMA 1 Salo. Before the action, researchers prepared learning tools consisting of syllabus, Learning Implementation Plans, Student Activity Sheets, teacher activity observation sheets, student activity observation sheets, and study group divisions.

The second stage is the execution of actions. At this stage, the teacher will make efforts to improve students' critical thinking skills by applying the Problem Based Learning (PBL) model. The learning process is carried out in accordance with the learning tools prepared by the researcher.

The third stage is observation. This observation was carried out by researchers on the mathematics subject teachers of class X IPA-2 of SMA Negeri 1 Salo as observers of the teacher's activities during teaching and peers as observers of students' activities during the learning process.

The last stage is reflecting. After taking action, the researcher and teacher can find out the shortcomings and advantages of the actions that are applied in the learning process. The results of reflection can be used as guidelines for planning new actions. This research will stop until there is an improvement in the learning process and an increase in students' critical thinking skills.

Data collection instruments used in this study are observation sheets, guidelines for scoring mathematical critical thinking skills, tests and documentation. Instrument validation in this study uses content validation type, where the instrument has the suitability of the content in revealing or measuring the indicators observed. Determination of instrument validation is carried out by the main supervisor and companion supervisor.

Data collection techniques used by researchers are observation techniques and test techniques. While the data analysis technique used is quantitative techniques and qualitative techniques. The following data analysis is used in this study:

1. Analysis of observation data
   Data from observations of teacher and student activities were analyzed descriptively to provide an overview of the learning process by applying the Problem Based Learning (PBL) model.
2. Analysis of test results data
   Analysis of test results is carried out to measure students' critical thinking skills after being given action. After obtaining the test results, it can be known the extent to which students' mathematical critical thinking skills are improved after being given an action. The percentage of students' critical thinking skills is seen from:
   a. Score each indicator of critical thinking achieved by all students
   b. Score all indicators of critical thinking achieved by each student.

obtained by calculation according Purwanto [5] as follows:

$$\mathrm{NP} = \frac{\mathrm{R}}{\mathrm{SM}} \times 100 \qquad (1)$$

Information:
NP = Percentage value sought

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R = The raw score obtained by students
SM = Maximum score of the test
100 = Fixed numbers

Then the researcher determines the KBKM qualifications of students. According Purwanto [5] the assessment criteriain as in Table 4. below:

Table 4. Criteria for percentage of students critical thinking skills

Percentage (%)	Criteria
$90\% \leq NP \leq 100\%$	Very Critical
$80\% \leq NP \leq 89\%$	Critical
$65\% \leq NP \leq 79\%$	Quite Critical
$55\% \leq NP \leq 64\%$	Less Critical
$NP < 55\%$	Not Critical

The next step, researchers calculate the number of students in each qualification. The researcher also calculates the average score of students critical thinking skills and is seen by the difference in average students' critical thinking skills in the first cycle and second cycle of the basic scores before the action with the following calculations:

$$\bar{x} = \frac{\sum x}{N} \quad (2)$$

Information:
$\bar{x}$ = Average score of students' critical thinking skills
$\sum x$ = Total score
N = Number of students

3. FINDINGS AND DISCUSSION

1. Findings
   1. Analysis of the percentage of KBKM students for each indicator in cycle I

Table 5. KBKM students each indicator in cycle I

No	Indicator	Percentage (%)	Criteria
1	Analyzing Questions	73,43%	Quite Critical
2	Identifying Assumptions	66,40%	Quite Critical
3	Determining Solution	83,59%	Critical
4	Determining Conclusions	71,87%	Quite Critical

Table 6. Number of student for each KBKM criteria in cycle I

Percentage (%)	Criteria	Number of Students	Percentage	Average KBKM
$90\% \leq NP \leq 100\%$	Very Critical	4	12,50%	73,82% Quite Critical
$80\% \leq NP \leq 89\%$	Critical	8	25%	
$65\% \leq NP \leq 79\%$	Quite Critical	12	37,50%	
$55\% \leq NP \leq 64\%$	Less Critical	8	25%	
$NP < 55\%$	Not Critical	0	0%	
Total		32	100%	

   2. Analysisof the percentage of KBKM students for each indicator in cycle II

Table 7. KBKM students each indicator in cycle II

No	Indicator	Percentage (%)	Criteria
1	Analyzing Questions	86,71%	Critical
2	Identifying Assumptions	82,03%	Critical
3	Determining Solution	90,62%	Very Critical

4	Determining Conclusions	82,03%	Critical

Tabel 8. Number of student for each KBKM criteria in cycle II

Percentage (%)	Criteria	Number of Students	Percentage	Average KBKM
90% ≤ NP ≤ 100%	Very Critical	10	31,25%	85,35% Critical
80% ≤ NP ≤ 89%	Critical	14	43,75%	
65% ≤ NP ≤ 79%	Quite Critical	6	18,75%	
55% ≤ NP ≤ 64%	Less Critical	2	6,25%	
NP < 55%	Not Critical	0	0%	
Total		32	100%	

3. Analyze the average percentage of KBKM students

Table 9. Persentage of KBKM students before the action and after the action

	Before the action	After the action	
		Cycle I	Cycle II
Total Score	312	378	437
Average KBKM	60,93%	73,82%	85,35%
Criteria	Less Critical	Quite Critical	Critical

Based on the data above, it can be concluded that students' critical thinking skills have increased in the first cycle and second cycle from the results of the basic scores before the action.

2. Discussion

Based on the analysis of data from observations of teacher and student activities during the study, the implementation of actions in cycle I and cycle II was carried out in accordance with the Problem Based Learning (PBL) model. This can be seen from the improvement of the quality of the learning process in cycle I and cycle II. Students begin to focus and actively participate in the learning process. Students have begun to dare to ask questions, express opinions during group discussions and students are more confident in displaying the results of their group discussions.

The results of the mathematical critical thinking ability test for students of class X IPA-2 increased in cycle I and cycle II from the results of the baseline score before the action. The percentage of students' critical thinking skills increased from less critical criteria with a percentage of 60.93% in the basic score, achieving criteria critical enough with a percentage of 73.82% in the first cycle and experiencing an increase again in the second cycle which reached critical criteria with a percentage of 83.35%. In cycle I students begin to be trained and accustomed to solving problems with high-level thinking skills, so students are sufficiently able to solve the problems given. In the second cycle the learning process has run well, so students are independent and accustomed to solving problems with high-level thinking skills that are given systematically in accordance with indicators of mathematical critical thinking skills.

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4. CONCLUSIONS

Based on the results of the finding and discussion, it can be concluded that the application of the Problem Based Learning models can improve the learning process and improve the critical thinking skills mathematicallyin class X IPA-2 students of Senior High School 1 Salo on Trigonometry material.

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